



Chemistry for All

**Reducing inequalities
in chemistry aspirations
and attitudes**

Supplementary material

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Supplementary material – Analysis
of interviews with students receiving
the programme from one provider

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Table 2: NVivo Attributes assigned to each of the 55 transcripts

Attribute Name	Value	Description
Likes science/chemistry	Yes/No/Unsure/NA	This applied to science in the early years then more specifically to chemistry. Any positive answer was recorded as yes.
Chemistry difficulty	Easy/Difficult/Both/NA	Again science in the early years. Both was assigned when students said there were easy parts and difficult parts (most common)
Maths difficulty	Easy/Difficult/Both/NA	Same as above for maths
Chemistry useful	Yes/No/Unsure/NA	A yes was assigned when students indicated science/chemistry was either important or useful
Family and chemistry	Yes/No/NA	A yes was recorded for any family member either working in a chemistry related career or studying chemistry
Chemistry out of school	Yes/No/NA	A yes was assigned if students were involved in any science/chemistry activity that was not school-related.
Aspires to do chemistry	Yes/No/NA	A yes was assigned if students expressed an interest in studying chemistry at university level.

Anna, Katie and Liane saw themselves as doing 'OK' in science then chemistry. Anna said she 'was not amazing' but all right. She like most students judged her performance on grades. Brian and Lucy were confident in science and chemistry throughout years 10-11. Brian describing his performance as 'pretty well' across the years. He and Lucy were grade 9 students. Edward was pleased with his consistent grade 9s and saw himself as doing well in chemistry. Martin was grade 9 and also felt he was doing well. Nathan described himself as doing very well in year 10 but by year 11 'was all right but not brilliant'. Though there was clearly a range in how students perceived they were 'getting on' in chemistry, it is possible that the means of judging performance could be expanded from simply test marks/grades. However such assessments by students are a reflection of a performance culture.

Self-reflection and peer

focused on answers to the question of what students do to succeed because these revealed differences in how higher achieving students engaged with self-motivated learning and revision. For some students it was simply a matter of 'getting your head down', 'behaving in classes' or 'paying attention' in addition to reading through their work over and over until it 'sticks in their head'. Some students took more responsibility for not being 'spoon-fed' by the teacher and writing down their own supplementary notes. Others relied on teacher feedback in order to know what to focus on. For those students who recognised themselves as having a poor memory flashcards and making posters were useful. Some students involved peers, parents or siblings in testing their knowledge. School C gave students access to an online testing system they called 'ducake' and all of those interviewed made use of this to set themselves questions on topics they were revising.

Anna and Edward who had self-conessed poor memories used the techniques of writing things down and flashcards. Brian's strategy included going over things and self-testing then going back. In year 10 he also developed a way of looking things up when they popped into his head and both he and Lucy used a wide range of resources including YouTube, VCS, video pods. In the early years Liane felt that she wanted to work things out for herself but became more reliant on

reported in the younger age range outside the experience of science was minimal in the later years.

Anna and Edward's experience of family working or engaging in science was minimal. Brian had three older brothers who all went to different universities to study chemistry one after the other. He felt there was an expectation for him to follow suit and he seemed happy with that. He talked a great deal about science experiences all around particularly in later years. Nathan also had a close older sibling with whom he discussed school science. Diane's step mother was a pharmacist and was mentioned each year as an influence she was involved in science at home with Diane. Katie and Martin had some early experiences of doing home experiments or visits but little engagement from family members other than help with school and options. Lucy had no family members working in science but engaged in conversation with her mother about options. She perceived how science came into many aspects of

which included different parts of topics broken down that the students coloured in themselves once you had got them' in addition to test scores and feedback from teachers. So self-evaluation was now part of the learning strategy for year 10. By Year 11 Brian was confident of doing well in his GCSE Chemistry he had just had a grade 5 in an internal exam and needed a grade 4 minimum to do A level. Brian also liked maths and thought he was quite good at it throughout finding it easy.

Self-reflection

Brian was able to describe in Year 11 his strategy for revising for tests which involved going through everything in his book waiting an hour then going back to see if he had remembered it he also reporting asking the teacher in

Self-Confidence

In Year 9, Iane thought she was doing OK in chemistry. She was being invited by the teacher to be part of the intervention (her perception was that the teacher had chosen her as she needed help to make progress which she appreciated). She saw feedback from her teacher as the main indicator of her progress (unlike others who focused primarily on grades) though she acknowledged grades as an indicator. In Year 10 she felt again that she was doing OK in chemistry but not one of her stronger subjects but not one of her weaker ones either. She again cited teacher feedback as her main indicator of progress but also her 'target'. In Year 11 she was still doing OK. With regard to maths in Year 9 Iane felt that maths was one of her weaker subjects but she was doing all right in her set. By Year 10 she had 'got her head down more' and was finding it quite easy. Her willingness to work things out for herself was clearly having a positive impact all round.

Self-Motivation

Iane's main strategy for getting to grips with something difficult was to first try and work it out for herself but then she would ask her teacher or her partner. In Year 10 she elaborated that she mostly relied on teacher feedback and constantly working on revision using flash cards or posters. She also mentioned getting her step mum to ask her questions on a topic. In Year 11 she summarised her main strategies as 'revise listen make notes'.

Aspirations

In Year 9 Iane already expressed a wish to become a pharmacist. Her step mother was a pharmacist and she herself liked the idea of having a career where she was helping other people. At this stage she also thought that she would carry on doing biology and chemistry because they would be of benefit. She could see that it would benefit her job as a pharmacist. In Year 10 Iane had broadened her aspiration to 'something to do with a hospital' such as a nurse or 'someone who does medicine' like her aunty (a nurse) or step mum (pharmacist). She was doing double science and thought she might carry on with science after Year 11 but she was still making her mind up about what she wanted to do. In Year 11 she said she could see herself being a chemist or a psychologist.

Factors

Iane's step mother was a pharmacist and clearly influential to Iane's aspiration. In Year 9 Iane reported that her step mum came home with stories about work that made the job sound really fun. She also had a young cousin who was interested in science and wanted to share her experiences with Iane. Iane herself wanted to show her family one of the Chemistry 'For All Experiments' she had done (glow sticks) and her step mum asked her questions about this and other science learning. In Year 10 both her step mum and aunty (a nurse) were constantly going on about how important science is and all that'. She cited her step mum continuing to take an interest in science in Year 11.

Interests

As well as the inspiration of the glow sticks activity Iane was inspired by her first trip to the provider (Year 9) where she recalled making things like vaseline and measuring things out. She really enjoyed that because she could relate to herself in the future when 'was doing that'. In Year 10 she reported having listened to the university students talking about what they did and this sounded 'really good'. She also talked about the glow sticks and the murder investigation she had done the year before in Year 9. She enjoyed those experiences. In Year 11 she was positive about how the interventions had made her more interested in chemistry and also increased her knowledge. She was unsure as to whether the events had any influence on her aspiration post-16 but she was more aware of chemistry-related careers.

Education and Year 11

Value

Edward favoured Biology and construction over other subjects because they were practical subjects but liked chemistry (Year 9). He liked seeing how things worked (the practical aspect of chemistry). He could see the value of chemistry as opening lots of doors for jobs (eg doctors or chemists). Though he did not aspire to these he thought chemistry might have value for his aspiration to be an electrician. His views in Year 10 were similar chemistry was an important subject if you were going to follow a particular career. In Year 11 he was mostly focused on the importance of getting a good grade in his GCSE science as this would help him get to university college.

Scientific Competence

In Year 9 Edward reported that he was doing the topics of structure of the atom and exo- and endothermic reactions in chemistry. He liked the practical side and also the group work they did in practicals as this was quicker and easier to get data and go through it'. In Year 10

actually gone beyond it (grade 10). He acknowledged that his memory was not the best for remembering things. In Year 11, he thought he was still doing well in chemistry as he was consistently getting grade 10 for his work.

Self-reflection

For success in Year 10, Edward reported using revision though he always struggled to remember things. He used flash cards went over questions and answers and would get someone to ask him questions. In Year 10 he said he paid attention in class took notes recognised he could not be 'spoon fed' by the teachers he took responsibility for making the most of his classroom experience. In Year 11, he did add that he worked on feedback from teachers to improve he also reported doing a lot of revision using his notes and websites.

Aspirations

In Year 10, Edward expressed his wish to become an electrician. He was not sure whether he would carry on with chemistry post-16 as he was uncertain as to whether he would need it for his chosen career. In Year 10 he was also keeping open the idea of doing something with sport but was still primarily fixed on becoming an electrical engineer. He was not sure whether he would do chemistry post-16 as engineering was his focus. In Year 11, he was more definite in that he was intending to do electrical installation. It seems that there is an original idea that opens up in Year 10 and reverts back in Year 11. Much may have had to do with having to make a college choice so Edward had applied to college to do an NVQ electrical installation for which he needed good grades in 10 (omin... e. In 15 (ible) mtion... websit... ngl... C /P... ang en-GB) / C... 5... BT0 Tw... 0 0 0 . 0

how she was getting on. In Year 9 she saw herself as being better at biology and chemistry than physics. She described her progress as 'not bad but not amazing' being guided in this by her test results. She felt she was doing OK in Year 10 through persevering to get her head round it. She and many other students cited the use of Duolingo or using online revision questions. When she does an Duolingo question and gets it wrong she asks her teacher for help. By Year 11 Katie thought her progress was 'good' from her recent mock exam results she also appreciated going over exam questions in class because these helped her to know she was getting on well. Katie had a mixed view on maths – most topics were OK but she struggled with some. Her responses regarding maths were similar in subsequent years some aspects she found difficult others not.

Self-reflection

In Year 11 Katie reported revising at home using printed worksheets. She used a whiteboard as a writing

Self-Reflection

Mathan thought he was doing 'very well' in science in Year 9 as he was getting good grades. This continued in Year 10 when he was told he could improve he worked to improve and this showed he was making progress by doing the next steps. In Year 10 he thought he was doing all right but not brilliant' he had recently got quite high marks on a test. He did not report having any difficulty with progress in Year 10. He thought he was better at maths than science describing it as both easy and difficult.

Self-Reflection

To help himself make progress Mathan asked his friend and also the teacher. He thought it was important to listen in class and not get distracted. In Year 9 Mathan was more focused on revising to make progress. He would make a poster at home and keep going over things until they 'stuck in your head so you know it'. He started using 'ducake' in Year 10 setting his own questions and marking the answers himself and saw revision papers as important for revision in Year 10.

Analysis

In Year 9 Mathan thought he would do something with 'Art or music' but he did not know what he would do leaving school other than try to get a good job which might involve maths. In Year 10 however he seemed more fixed on working with something to do with sport which persisted into Year 10 but by then he was also considering going into the police. He talked about forensic science having interested him (at the intervention day). He thought he would carry on doing science post- probably chemistry. By Year 11 he had decided he wanted to be an engineer and 'Power' so maths and science would be important including chemistry.

Familiarity

Each year Mathan talked about an older sister who was doing science she was one year older than him they had discussions about their school science. When he was in Year 9 and she was in Year 10 she reported that she was disappointed that she was stuck in a lower set and so could not do the higher paper even though she got a very high score. He continued to discuss science with his sister each year she wanted to be a forensic scientist. This experience seemed to have a strong impression on Mathan. Outside of school he did not do science he played with his friends and studied like that.

Learning

Mathan's recollection of Year 9 interventions was rather vague but he remembered the professor coming in. In Year 9 he was more forthcoming describing the university event in some detail. He enjoyed the interventions and thought they helped his learning. In Year 10 he recalled the forensic science day again and also the lesson on bonding that they had done in school with the intervention team. He thought Chemistry for All helped him to see what he might enjoy and be good at. Because he had always enjoyed chemistry he did not see that Chemistry for All had changed his view he was positive about his awareness of careers through Chemistry for All.

Conclusion

In this report I have focused on providing the narrative stories or 'cases' of individual students that I was able to interview over many years. As stated in the introduction the analysis was very much driven by the interview schedule and the responses elicited in these two schools. There are other elements of the Chemistry for All research that have different concepts and foci. This report is intended to complement the main body of work by providing insights that only such an interview study can.

It was encouraging to find that almost all students had a high regard for the value of science and justified their views with ample evidence of how science has societal value as well as a utilitarian value for individuals. I think this is important for these young people as citizens to recognise that science and evidence can aid society even if they do not opt for science or chemistry-related careers. An intervention such as the one these students experienced clearly reinforced this value as their responses in Year 10 showed. Practical work was clearly an important feature of science and chemistry that made the subject interesting. The intervention provided novel practical experiences that were appreciated by students. Groupwork in class was highly valued for learning and gaining confidence. The point at which the 'newness' of chemistry made it appear difficult and less attractive than other subjects) needs particular attention presentation and focus of chemistry in the intervention that allowed for familiarity with important terms and concepts was seen as helpful.

Students had different ways of 'pressing how they get on' in chemistry but most used their grades and test results and benchmarks. It would be interesting to see whether other kinds of feedback could help them think differently about their progress and about themselves as potential chemists. Found intentions regarding future choices and careers to be more fixed in younger students than anticipated though this was variable. So though the intervention impacted very positively on interest learning and value of chemistry it did not appear to have impact on subject and career choice. The cases show that family influence or role models could play an important part in students' aspirations more so than an intervention of this kind.

References

Ballaburn A. Seton J & Goodwin (2010). Chemistry. The essential spark for engagement. Education in

2. Appendix 1: Chemistry for All interview schedule

1. What is your name?
2. What do you think about science/chemistry?
3. Do you think science/chemistry is important?
(Prompt with respect to value of science, how it helps)
4. Do you like science/chemistry at school?
(Prompt for what they like/do not like about science at school)
5. What sort of things do you do in chemistry?
(prompt with classroom strategies)
6. How do you get on in chemistry? (Prompt to see how they see themselves, successful) Be 5 s C BTeg q0out